T5.1 THE DYNAMICS OF NOVA SCOTIA'S CLIMATE

The main features of Nova Scotia's climate are ample and reliable precipitation, a fairly wide but not extreme temperature range, a late and short summer, skies that are often cloudy or overcast, frequent coastal fog and marked changeability of weather from day to day. These features can be related to four basic factors:

1. the prevailing westerly winds
2. the interactions between the three main air masses which converge on the east coast
3. Nova Scotia's position astride the routes of the major eastward-moving storms
4. the modifying influence of the sea

WIND SYSTEMS

The basic eastward movement of the wind systems (known as the westerlies) over North America is a result of the general circulation of warm air from the equator towards the pole being deflected to the right by the Coriolis effect, an inertial force caused by the rotation of the earth (see Winds in T6.1). The westerlies, though subject to much local disturbance, bring Nova Scotia a continental type of climate, albeit much modified by the waters that surround the province. As a result of air moving across a large land mass, which heats up and cools down more quickly than a body of water, a continental climate experiences larger daily and seasonal temperature changes than a maritime climate. Nova Scotia therefore experiences warmer summers, colder winters and higher snowfall than might otherwise be expected of an area of land which is almost an island.

MAJOR AIR MASSES

Satellite photography, computer modelling, a greater knowledge of the structure of weather systems and a better understanding of the physical processes that control our weather have all led to a much-reduced use of air-mass concepts. Air-mass theory is still used descriptively, however, and is very useful to introduce people to the disciplines of meteorology and climatology.

Much of the variability of the weather is caused by the shifting positions of the three main air masses that dominate the eastern seaboard. Continental arctic air from the northwest is very dry and cold in winter. Maritime polar air, moving in from the north or northeast, has been somewhat warmed by its passage over the ocean and is cool and moist. Maritime tropical air from the south or southwest is warm and moist.

Fronts

The boundary where two air masses meet is called a front. If the cold air is advancing, the front is a cold front. If the cold air is retreating, the front is referred to as a warm front. The clouds and precipitation that accompany the passing of a front are caused by the lifting of the warmer air mass over the wedge of cold air, causing the warm air to cool, which triggers condensation. Cold fronts are steeper than warm fronts and have relatively narrow bands of clouds and precipitation. Cold-frontal precipitation tends to be short lived and is frequently showery. On the other hand, warm fronts, with their low slopes, have much larger areas of clouds and precipitation, giving many hours of continuous precipitation.

Jet Streams

At high altitudes within the westerlies, 10 to 15 km above the surface, narrow bands of strong winds (referred to as jet streams) can occur over long distances. Television weather broadcasts often feature a map showing the location of the jet stream. Jet streams occur where the contrast between warm and cold air masses is the greatest. This contrast is greatest in winter, causing jet streams to be strongest and more continuous (i.e., longer) at that time of year. In the short term, the jet stream can give a good indication of where disturbances will track. The location and strength of the jet stream and its pattern are constantly changing, thus forecasting the tracks of storms for more than twelve hours to one day is not recommended.

Pressure Systems

Two semi-permanent pressure systems influence the circulation of air (Figure T5.1.1).[1] In the summer the Bermuda and Azores high, an area of persistent high pressure east of Bermuda, feeds hot and humid air into the southern United States, where it may be picked up or entrained by the prevailing westerlies.

The Icelandic low is situated near Iceland and southern Greenland in the winter, but tends to weaken and move westward toward Hudson Strait in summer. Most of the low-pressure systems, or cyclones, which sweep across North America eventually die out in the area of the Icelandic low.

STORM TRACKS

A prominent feature of Nova Scotia's weather is the fairly frequent movement of low-pressure systems over the region. Three storm tracks or streams of low-pressure systems converge:

1. one that moves into British Columbia and the Yukon from the Pacific Ocean and moves across the country, often reinforced by moist air from the Mississippi Valley
2. one that develops in the midwestern United States and moves across the Great Lakes
3. one that originates in hot, humid air over the tropical Atlantic Ocean, the Caribbean or the Gulf of Mexico and then sweeps around, first westward, then joining the westerlies to move up the east coast of the continent, bringing some of the most significant storms to the Atlantic provinces.

COASTAL INFLUENCES

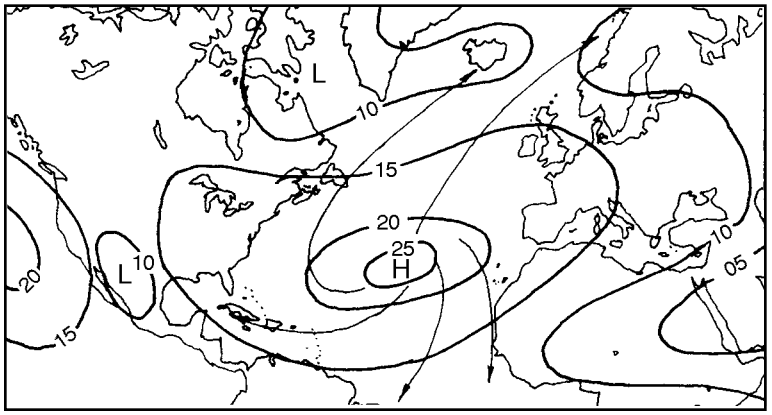
The weather that moves into the Atlantic region is modified in a number of ways by the seas that almost completely surround the province. The high heat capacity of water means that the sea is much slower to warm up and cool down than land. Cold winds from coastal waters therefore delay the arrival of spring. Similarly fall is extended, and the onset of winter is delayed. During hot weather, the influence of the cold Bay of Fundy (Unit 912) waters keeps the Fundy shore cool, while the Annapolis Valley (District 610), which is protected from the intrusion of the cool air by the North Mountain (District 720), is frequently as much as 15°C warmer.

Sea Breeze

Along the coast in late spring and summer, in the absence of strong pressure patterns, a local convection cell called a sea breeze frequently develops. During the day, the air over land warms and rises, causing a cool breeze to move in from the sea. Sea breezes are strongest when the difference between land and sea temperatures is the greatest: in late spring and early summer. The difference in temperature between the area under the influence of a sea breeze and further inland can be as high as 20°C. At night this air movement is reversed, as the land cools more quickly than the sea.

Sea Fog

Sea fog is another example of a coastal influence. When warm, moist air from the south or southwest moves over the colder waters of the Nova Scotia Current, condensation occurs and sea fog forms. Sea fog is blown by the wind across the coastline, moving inland during the night and retreating towards the sea during the day under the influence of the sun.



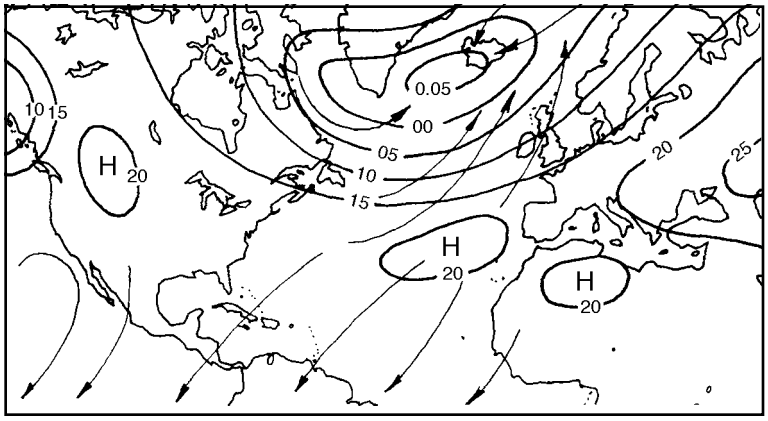


Figure T5.1.1: Semi-permanent Atmospheric Pressure Systems. (Above) – Summertime, Bermuda high. (Below) – Wintertime, Icelandic low. Units shown are millibars above 1000 millibars. (Modified after Hare and Thomas.[1])

Cold Inland Winds

In winter, another coastal influence is experienced in areas where cold winds blow inland off open water. Cold, dry arctic air masses pick up a lot of moisture and become very unstable in low levels when flowing over open water. These modified air masses rise when they hit the coastline, and the moisture precipitates out as heavy snow.

The areas most affected by the heavy snow are the Annapolis Valley, the Gulf coast of Cape Breton and northern Nova Scotia. For the latter two areas, the heavy snow in onshore flows ceases when the Gulf of St. Lawrence freezes over. The high tides in the Bay of Fundy, however, prevent the formation of an ice cover, and the Annapolis Valley is subject to this kind of weather for a larger part of the winter.

Pack Ice

Pack ice, which forms in the Gulf of St. Lawrence and moves downstream with the Nova Scotia Current in winter, is a further cooling influence in spring. Off southwest Nova Scotia, ocean surface temperatures are warmer in winter and cooler in summer than off the Eastern Shore. Consequently, the climate of southwest Nova Scotia is milder.

Freezing Spray

Freezing spray occurs when a strong flow of cold air streams out over coastal waters. The higher the wind speed, the greater the amount of freezing spray. The wind blows water droplets from the crests of the waves and cools these droplets to well below freezing. Upon contact with a solid object, such as the superstructure of a vessel, the cooled droplets freeze.

CLIMATIC VARIABILITY

The number of storms, their intensity and tracks vary considerably from year to year. Our weather in Nova Scotia can therefore vary considerably and still be considered within the normal range. There are some influences which are not considered normal, such as the eruption of volcanoes and the El Niño effect. Mount Pinatubo in the Philippines erupted in June 1991, spewing massive amounts of volcanic ash into the higher atmosphere. Winds distributed this fine ash throughout a large portion of the world's atmosphere. The ash reflected some of the sunlight back into space, reducing the amount of light that reached the earth's surface. At the peak of its influence, the average temperature of the earth was reduced by 0.5°C. The effect of such an eruption can last two to three years before all the volcanic ash has settled out.

From time to time, the normal pressure pattern in the equatorial Pacific Ocean reverses and the trade winds weaken. As a result, the upwelling of cold water along the west coast of South America ceases and a large pool of warm water forms in the eastern Pacific. This phenomenon is referred to as El Niño and, even though it seems remote, has a profound influence on Nova Scotia's weather as well as on many other areas in the world. The 1991–92 El Niño event gave Nova Scotia a very cold and snowy winter. The El Niño occurs in intervals from two to ten years, with varying degrees of intensity, and is a classic example of how our weather is influenced by phenomena in distant areas.

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Associated Topics

T4.1 Post-glacial Climatic Change, T5.2 Nova Scotia's Climate, T6.1 Ocean Currents, T6.2 Oceanic Environments, T9.1 Soil-forming Factors, T10.3 Vegetation and the Environment, T12.5 Climate and Resources

References

1 Hare, F.K., and M.K. Thomas (1974) *Climate Canada*. Wiley Publishers of Canada, Toronto.

Additional Reading

• Battan L.J. (1984) *Fundamentals of Meteorology*. Prentice-Hall, Englewod Cliffs, N.J.

